OPERATION & MAINTENANCE HANDBOOK

MODEL 220

DATA GENERATOR

Part Number 37001-215

General Electric Company

INSTRUMENT REGISTRY

SYSTRON-DONNER CORPORATION

DATAPULSE

10150 W. Jefferson Blvd., Culver City, Calif. 90230

Telephone: 213-836-6[illegible] TWX: 910-340-6766

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DATAPULSE DIVISION

SYSTRON DONNER CORPORATION

P.O. BOX 2549

CULVER CITY, CALIFORNIA 90230

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MODEL 220 DATA GENERATOR

The Model 220 Data Generator is a compact, high performance laboratory instrument capable of being clocked by an external source up to 20 MHz. Data output levels are variable from -4 to +5 V into 50 ohms. There are three NRZ data outputs: advanced, positive true and complement. RZ data can be generated by using the Model 220 in conjunction with the Datapulse Model 101 Pulse Generator. Each bit in the 16-bit data cycle can be individually programmed by front panel pushbutton and the data cycle can either be recycled automatically or recycled on command from an external source or a manual switch. Sync outputs coincidental with the clock, Bit 1 and Bit 16 are provided.

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LIST OF SCHEMATICS

Drawing Number	Description
41000-258	Block Diagram – Model 220 Data Generator
40000-491	Schematic – Data Generator
37001-211	Schematic – Front Panel Circuit Board Assembly
40000-490	Schematic – Power Supply

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SECTION I

SPECIFICATIONS

1.1 CLOCK RATE

An external clock source is required. The instrument may be slaved to +2 V signal with a 15 ns minimum duration at repetition rates from 0 to 20 MHz. There are no rise time limitations on the input signal. Input impedance is >390 ohms. Maximum safe input voltage is ±10 V.

1.1.1 Manual Clock

Data cycle (16-bit word) advances one bit each time the manual clock pushbutton is depressed.

1.2 DATA CYCLE

Fixed at 16 bits. Data content pushbutton determines the state (true/false) of each bit. Longer words may be generated by operating two or more units in series.

1.3 RECYCLE MODES

1.3.1 Continuous

Serial words repeated sequentially without interruption.

1.3.2 Command

A 16-bit word is generated for each command signal (+2 V pulse with 15 ns minimum width) or each time the manual recycle pushbutton is depressed. Maximum safe input voltage is ±10 V.

1.4 SYNC OUTPUTS

All sync outputs are >+2 V amplitude into 50 ohms. Pulse duration is approximately 15 ns. Output impedance is 50 ohms.

1.4.1 Clock Sync

Occurs at the data rate.

1.4.2 Bit 1 Sync

Occurs approximately 30 ns before the first bit of each 16-bit word.

1.4.3 Bit 16 Sync

Occurs approximately 30 ns before the sixteenth bit of each 16-bit word.

1.5 DATA OUTPUTS

Simultaneous positive true and complement data outputs are provided. The upper logic level is variable from -4 to +5 volts and the lower logic is variable from +4 to -5 volts when terminated with 50 ohms. Advance data output (positive true) occurs one bit period before the main outputs. The amplitude of the advanced data is fixed at +2 volts (lower level at 0 volts and upper level at +2 volts) when terminated with 50 ohms. All outputs have an impedance of 50 ohms (all output voltages double when the output is open circuited).

1.5.1 Amplitude

Difference between the upper and lower logic levels is limited to approximately 1 V minimum to 5 V maximum when the output is terminated with 50 ohms (2 V minimum to 10 V maximum open circuit).

1.5.2 Format

Positive true and complement NRZ. Output remains in the same state (true or false) for the entire bit period.

1.5.2.1 Parallel Operation (two or more units operated in parallel)

In the command recycle mode, parallel operation, bit 16 remains in the same state until the next recycle command is received. For example, if bit 16 is true, it will remain true until the next recycle command then it will shift to the state selected for bit 1.

1.5.2.2 Series Operation (two or more units operated in series)

In the command recycle mode, series operation, bit 16 remains in its selected state for only one clock period. For example, if bit 16 is selected true, it will remain true for one clock period then automatically return to the low level (false). For series operation remove the jumper between circuit points [PP] and [G] (Schematic 40000-491) and add a jumper between circuit points [PP] and [NN].

1.5.3 Polarity

Simultaneous positive true and complement outputs. Negative polarity or symmetrical outputs can be achieved by means of the upper and lower level controls.

1.6 OPERATING TEMPERATURE

0 to 40° C.

1.7 POWER REQUIRED

Approximately 25 W, 50–400 Hz at 105–125/210–250 V ac selectable by means of a multitap transformer and a range switch on the back panel.

1.8 PHYSICAL CHARACTERISTICS

The front panel has a brushed aluminum finish with black markings. The top and bottom covers are removable and the instrument has tilt-up brackets for bench use. All input and output connectors are BNC. The cabinet dimensions are 3½" H x 8½" W x 12" D. Weight is approximately 8 pounds.

1.9 ACCESSORIES FURNISHED

A power cord and an operation and maintenance manual.

1.10 ACCESSORIES AVAILABLE

Type 1005 and 1006 Rack Mounting sets, 2003A Power Termination, 2101 Inverting Transformer (for sync outputs only), 2302 Pulse Mixer, 2401 Rise Time Integrator and extra operation and maintenance handbooks. See Datapulse Technical Bulletin 2000 and price list for additional details.

SECTION II

CONTROLS AND CONNECTORS

Refer to Figure 2 - 1 for the following description of controls and connectors.

2.1 POWER Switch

Applies ac voltage to the primary of the power transformer and illuminates the pilot lamp.

2.2 DATA CONTENT Pushbuttons (1 through 16)

Determines the state of each bit in the data output. The bit is true when the pushbutton is depressed and false when the pushbutton is released.

2.3 MANUAL CLOCK Pushbutton

Advances the output data by one bit each time the pushbutton is depressed.

2.4 RECYCLE

2.4.1 Auto

In this position, 16-bit words are repeated sequentially without interruption.

2.4.2 Command

In this position, a single 16-bit word occurs for each command signal input (+2 V pulse with 15 ns minimum width) or each time the manual RECYCLE pushbutton is depressed.

2.5 MANUAL RECYCLE Pushbutton

Generates one 16-bit word each time the pushbutton is depressed, when the RECYCLE switch is in the COMMAND position.

2.6 OUTPUT LEVELS

The difference between the upper and lower levels of the data output is limited to approximately 1 V minimum to 5 V maximum when the output is terminated in 50 ohms.

2.6.1 Upper Level

Provides continuous control of the data output upper level from +5 V to -4 V when the output is terminated with 50 ohms or from +10 V to -8 V open circuit.

2.6.2 Lower Level

Provides continuous control of the data output lower level from +4 V to -5 V when the output is terminated with 50 ohms or from +8 V to -10 V open circuit.

2.7 CLOCK INPUT

Input connector for the external clock source. A +2 V signal with a minimum width of 15 ns is required.

2.8 RECYCLE COMMAND

Input connector for the recycle command signal. A +2 V signal with a minimum width of 15 ns is required.

2.9 SYNC OUTPUTS

All sync outputs have a +2 V amplitude into 50 ohms and a pulse duration of approximately 15 ns.

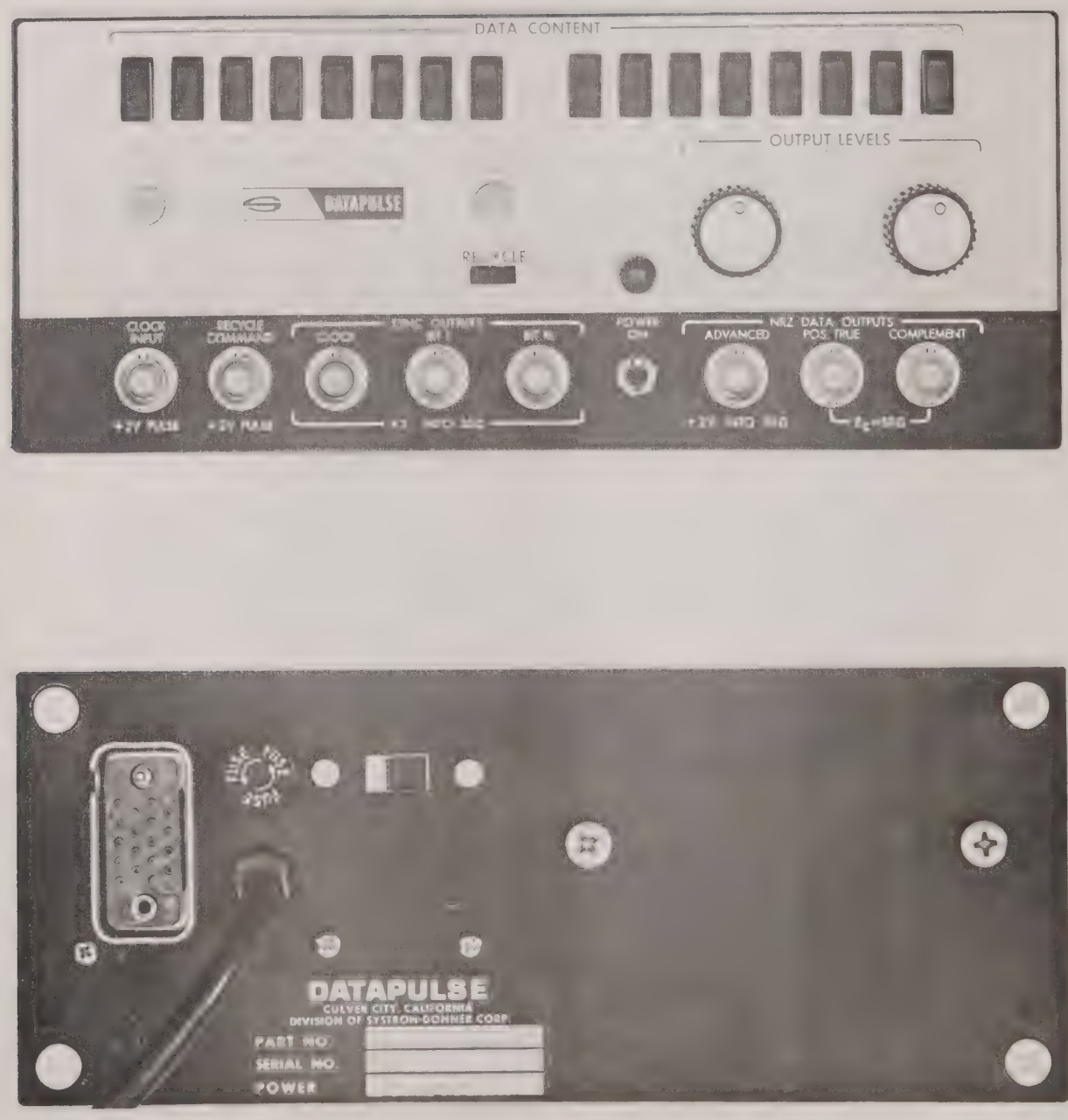


Figure 2-1. Model 220 Controls and Connectors

2.9.1 Clock

Output connector for the clock sync. This sync output occurs at the data rate.

2.9.2 Bit 1 Sync

Output connector for Bit 1 sync. This sync occurs approximately 30 ns before the first bit of each 16-bit word.

2.9.3 Bit 16 Sync

Output connector for Bit 16 sync. This sync output occurs approximately 30 ns before the sixteenth bit of each 16-bit word.

2.10 NRZ DATA OUTPUTS

2.10.1 ADVANCED Output

Output connector for positive true NRZ data that occurs approximately 1 bit period before the POS TRUE and COMPLEMENT outputs. Amplitude is fixed at +2 volts (upper level is at +2 V and lower level is at ground).

2.10.2 POS TRUE Output

Output connector for positive true NRZ data. Amplitude is variable by means of the upper and lower level controls.

2.10.3 COMPLEMENT Output

Output connector for data that is the inverse of the POS TRUE output. For example, if a bit is true at the POS TRUE output, it is false at the COMPLEMENT output.

2.11 115/230 V Selector (Back Panel)

Selects the transformer primary configuration for either 115 or 230 volts ac.

SECTION III

OPERATION

3.1 OPERATING INSTRUCTIONS

The Model 220 is self-protected and no combination of front panel settings will cause damage. The inputs and outputs are also protected against short circuits to ground and voltages less than 10 V. In case of a short circuit or input overvoltage, the +5 volt regulator will be disabled and no data outputs will be present. To restore the regulator to normal operation, remove the short or overvoltage connection and cycle the power switch OFF and ON. See note on page 4-4.

Section II explains the operation of all controls and connectors and paragraph 3.2 explains several applications.

3.1.1 Auto Recycle Operation

a. Set the power switch to ON. Connect the clock source to the CLOCK input. Set the clock source to the desired repetition rate and for a +2 V pulse with a duration of at least 15 ns.

b. Set the RECYCLE switch to AUTO.

c. Program the DATA CONTENT pushbutton as desired (depressed for a true bit, released for a false bit).

d. Set the OUTPUT LEVEL for the desired level. The maximum difference between levels is limited to +5 volts.

e. Connect the desired NRZ DATA OUTPUT to the load. If the load is not 50 ohms, terminate the output with 50 ohms at the load.

f. If synchronization is required, use the BIT 16 SYNC OUTPUT.

3.1.2 Command Recycle Operation

a. Perform paragraph 3.1.1 step (a).

b. Set the RECYCLE switch to COMMAND.

c. Connect another pulse source to the RECYCLE COMMAND input. Set the pulse source for a +2 V pulse and a 15 ns width. Set the pulse source for the desired command rate.

d. Perform paragraph 3.1.1 steps (c, d, e and f).

e. To operate the instrument in the MANUAL RECYCLE mode, disconnect the pulse source at the RECYCLE COMMAND input. Depress the MANUAL RECYCLE pushbutton for each data cycle desired.

3.2 APPLICATIONS

3.2.1 General

Any Datapulse pulse generator provides a suitable clock source for the Model 220. However, for maximum versatility, the Datapulse Models 88/99 or 101 Pulse Generators are recommended as ideal clock sources.

3.2.2 Variable Parameter Pulse Output

When a Model 101 Pulse Generator is available as a clock source it is possible to generate a variable parameter (RZ) output in addition to the NRZ outputs. Figure 3-1 illustrates the equipment set-up

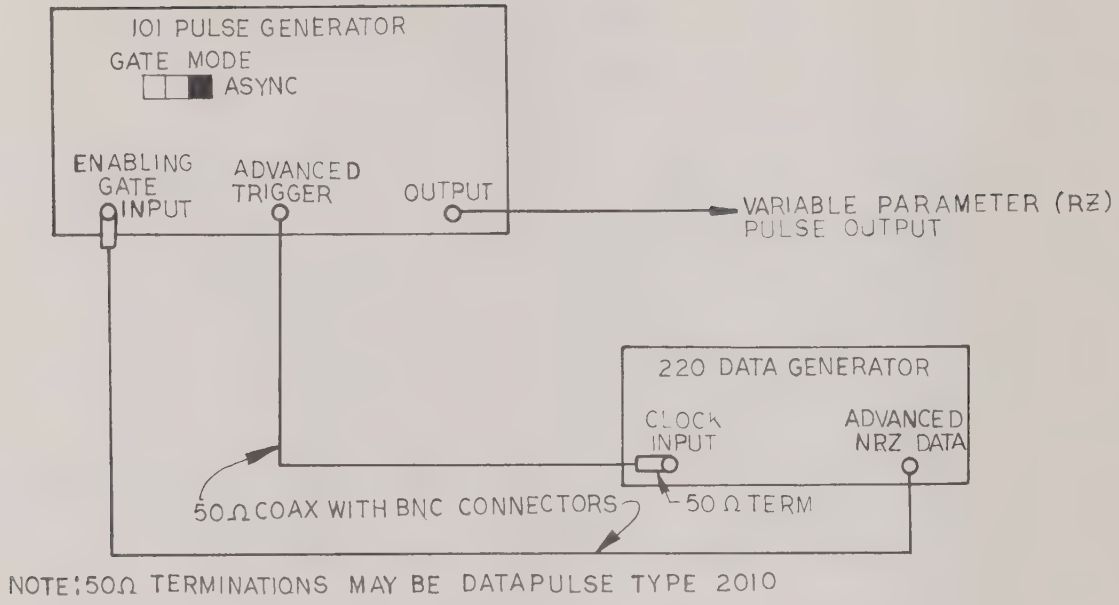


Figure 3-1. Variable Parameter Pulse

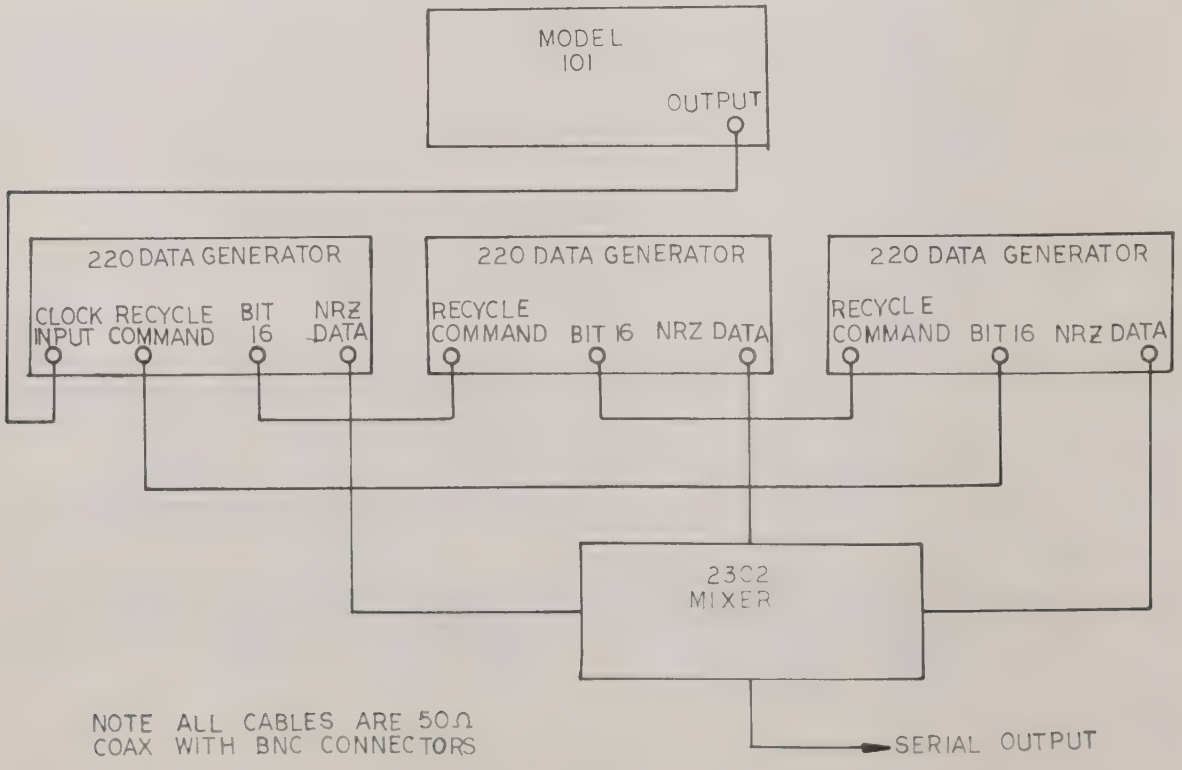


Figure 3-2. Serial Operation

for a variable parameter pulse. The Model 101 Pulse Generator must be in the ASYNC GATE mode when the Model 220 is connected in the configuration shown in Figure 3-1. The output of the pulse generator is RZ data with parameters (delay, width, amplitude) controllable by the pulse generator. The data content of the output is determined by the setting of the Model 220 data content pushbuttons.

3.2.3 Series Operation

Connecting several Model 220 Data Generators in series as illustrated in Figure 3-2 will result in an output word length that is a multiple of 16 bits. For example, if three units are connected in series a 48-bit (16 x 3) word will be generated.

For series operation, move the jumper between circuit points [PP] and [G] (reference Schematic 40000-491) to circuit points [PP] and [NN]. Although the outputs of the series operated units may be connected directly together, better results without loss of amplitude can be achieved by connecting the outputs through a mixer (Datapulse Type 2302 recommended). It is also recommended that all units have the same upper and lower level settings.

3.2.4 Parallel Operation

When the Model 220 arrives from the factory, it is already in the configuration for parallel operation. To operate two or more units in parallel, they must be connected as shown in Figure 3-3. The only limitation to the number of units that may be operated in parallel is the driving capability of the clock source.

3.2.5 Variable Parameter Series Operation

A combination of the series (Figure 3-2) and variable parameter (Figure 3-1) operation as illustrated in Figure 3-4 will result in an RZ (variable parameter) output with word lengths (data cycles) greater than 16 bits. All units must be connected for series operation (see paragraph 3.2.3). There are no limitations on the data content of the output. Any bit can be programmed as desired.

3.3 FUNCTIONAL VERIFICATION

The following procedure provides a brief operational check of the instrument and an introduction to its controls.

3.3.1 Equipment (or equivalent) Required

a. Two pulse sources capable of 20 MHz repetition rate, $>+2$ V amplitude and >15 ns pulse width. Datapulse Model 110B Pulse Generator recommended.

b. A dual-trace real-time oscilloscope with a 50 MHz bandwidth. Tektronix Type 546 with a Type 1A2 plug-in recommended.

c. Two 50 ohm, 2 watt terminations. Datapulse Type 2010 recommended.

d. Four 50 ohm coaxial cables (2-3 feet long) terminated with BNC connectors.

3.3.2 Data Output Verification

a. Set the instrument controls as follows:

Control	Setting
DATA CONTENT pushbuttons	1, 3, 5, 7, 9, 11, 13, 15 depressed
UPPER LEVEL	0
LOWER LEVEL	-5
RECYCLE	AUTO

b. Monitor the POS TRUE and the COMPLEMENT outputs on the dual-trace oscilloscope. Trigger the oscilloscope

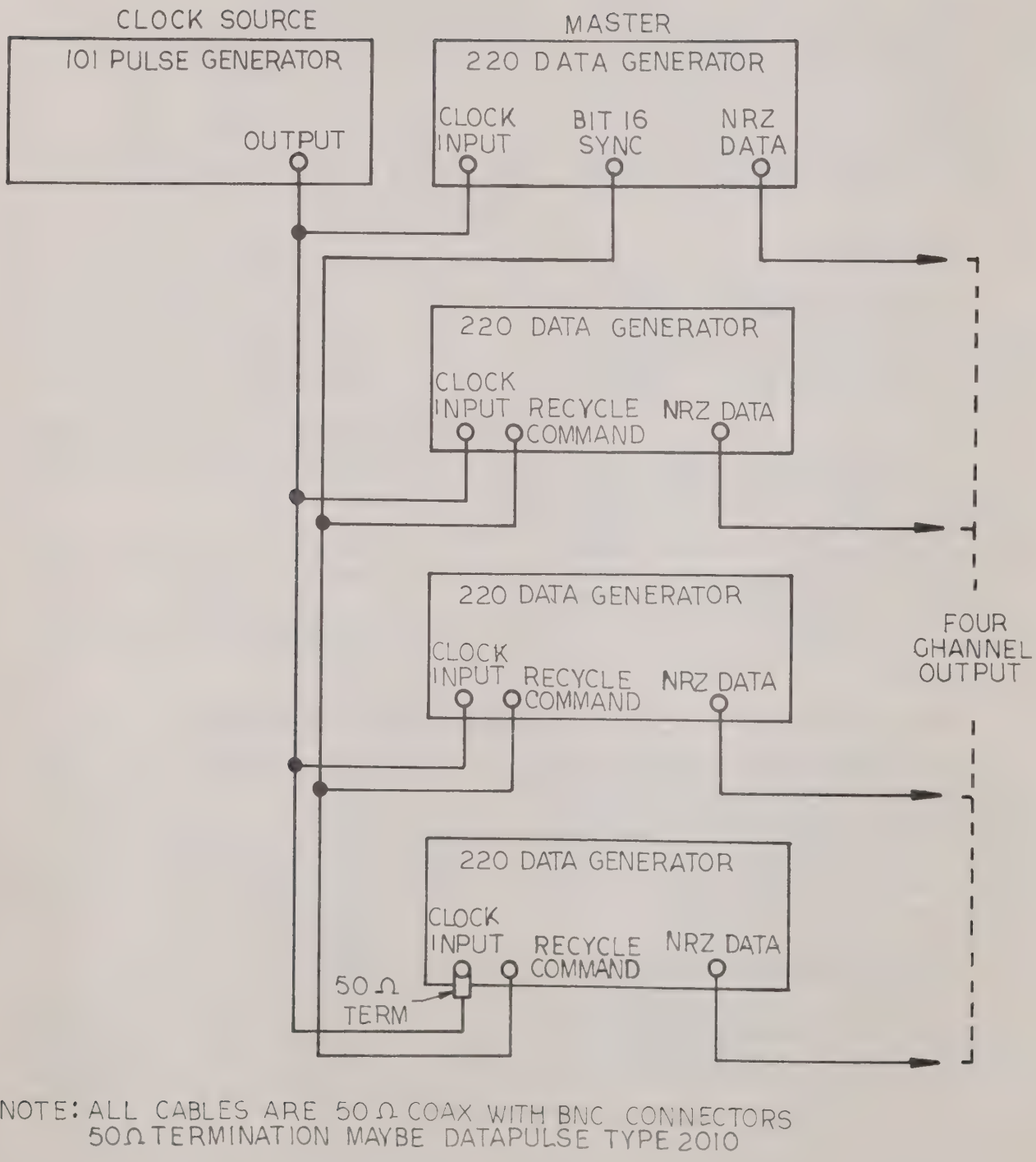
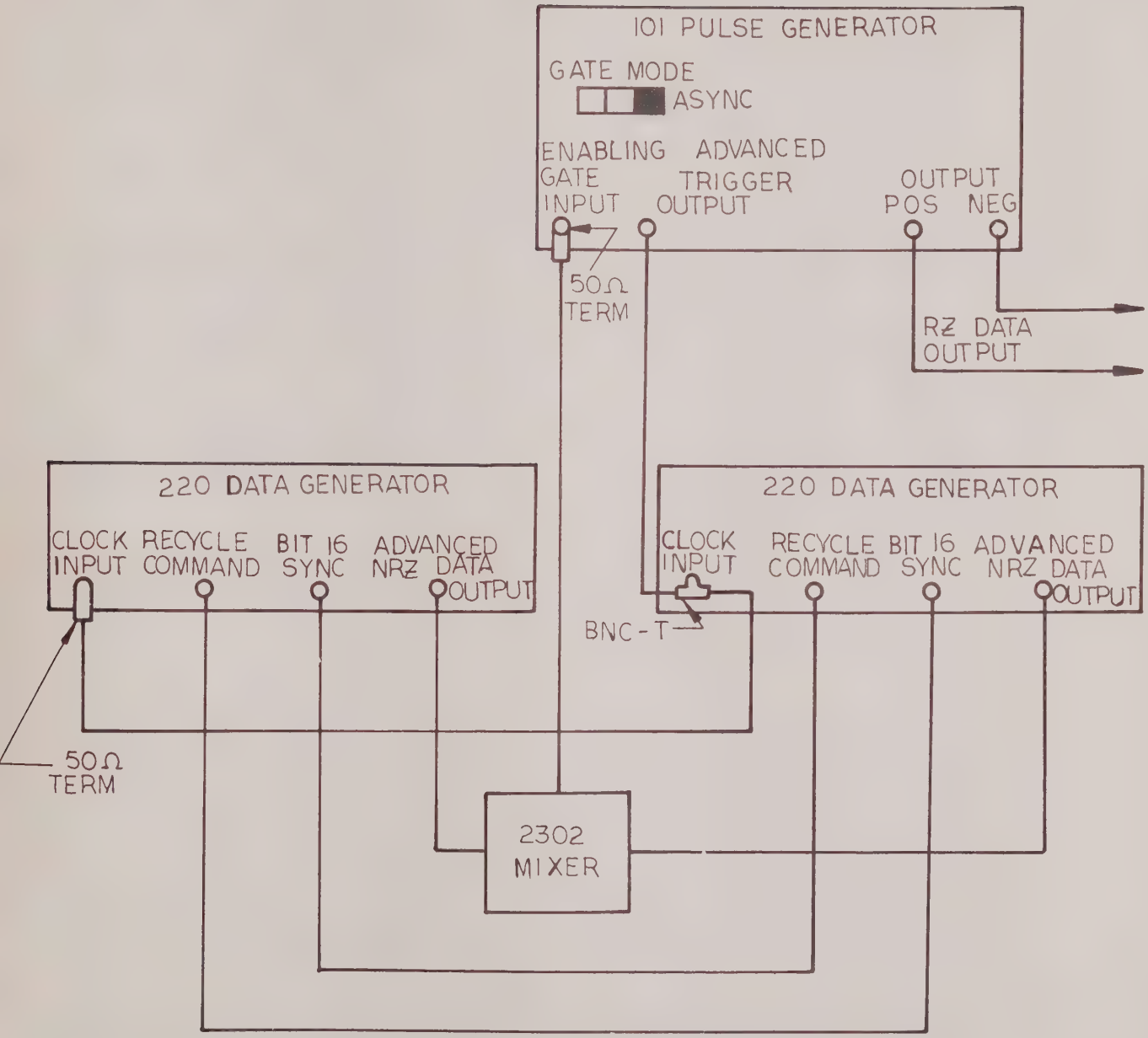


Figure 3-3. Parallel Operation



NOTE: ALL CABLES ARE 50Ω COAX WITH BNC CONNECTORS.
50Ω TERMINATIONS MAY BE DATAPULSE TYPE 2010

Figure 3-4. Variable Parameter Series Operation

from the BIT 1 SYNC OUTPUT. Terminate all three outputs with 50 ohms at the oscilloscope.

c. Connect one of the pulse sources to the CLOCK INPUT. Set the pulse source for 1 kHz repetition rate, > +2 V amplitude (0 volt baseline) and a width of >15 ns.

d. Verify that bits 1, 3, 5, 7, 9, 11, 13 and 15 are true and bits 2, 4, 6, 8, 10, 12, 14 and 16 are false at the POS OUTPUT. Verify that the bits are the opposite logic level (odd numbered bits false, even numbered bits true) at the COMPLEMENT OUTPUT.

e. Release the odd numbered DATA CONTENT pushbuttons and depress the even numbered pushbuttons. Verify that bits 2, 4, 6, 8, 10, 12, 14 and 16 are true and bits 1, 3, 5, 7, 9, 11, 13 and 15 are false at the POS OUTPUT. Verify that the bits are the opposite logic level (odd numbered bits false, even numbered bits true) at the COMPLEMENT OUTPUT.

f. Using the OUTPUT LEVEL controls, verify that the upper logic level of the data can be varied from approximately -4 V to +5 V and the lower logic level can be varied from approximately -5 V to +4 V.

NOTE: The difference between the upper and lower logic levels is limited to approximately 1 V minimum to 5 V maximum.

g. Disconnect the COMPLEMENT OUTPUT from the oscilloscope and connect the ADVANCED OUTPUT. Verify that the advanced data has the same format and content as the POS TRUE OUTPUT but occurs one bit period before the POS TRUE OUTPUT. Verify that the amplitude of the advanced data is approximately +2 volts (0 volt baseline).

h. Disconnect the pulse source from the CLOCK INPUT.

i. Depress the MANUAL CLOCK pushbutton several times and verify that the dc level at the POS TRUE OUTPUT changes in accordance with the setting of the DATA CONTENT pushbuttons.

j. Reconnect the pulse source. Increase the repetition rate of the pulse source to 20 MHz, and verify that the instrument can be triggered at that rate.

k. Connect one pulse source to the CLOCK INPUT and the other pulse source to the RECYCLE COMMAND input.

l. Set the pulse source at the CLOCK INPUT to 20 MHz repetition rate, >+2 V amplitude (0 volt baseline) and > 15 ns width. Set the pulse source at the COMMAND RECYCLE input to 100 kHz repetition rate, >+2 V amplitude (0 volt baseline) and >15 ns width.

m. Set the RECYCLE switch to COMMAND and verify that 16-bit words occur at approximately 20 MHz clock rate with approximately 10 μs separation between each word.

n. Disconnect the pulse source from the RECYCLE COMMAND input. Set the clock source for 100 Hz.

o. Depress the MANUAL RECYCLE pushbutton and verify that a 16-bit word occurs each time the pushbutton is depressed.

3.3.3 Sync Output Verification

a. Connect the pulse source to the CLOCK INPUT. Set the pulse source for 20 MHz repetition rate, $>+2$ V amplitude (0 volt baseline) and a width of >15 ns. Set the Model 220 controls the same as in paragraph 3.1.2 step (a).

b. Monitor the POS TRUE OUTPUT and the BIT 1 SYNC OUTPUT with the dual-trace oscilloscope. Terminate both outputs with the 50 ohm termination at the oscilloscope input. Trigger the oscilloscope from the BIT 1 SYNC OUTPUT.

c. Verify that the BIT 1 SYNC OUTPUT has an amplitude of $>+2$ V and a duration of $\sim$15 ns and verify that it occurs approximately 30 ns before the first bit of the data output.

d. Disconnect the BIT 1 SYNC OUTPUT from the oscilloscope and monitor the BIT 16 SYNC OUTPUT. Verify that the BIT 16 SYNC OUTPUT has an amplitude of $>+2$ V and a duration of $\sim$ 15 ns and that it occurs approximately 30 ns before the sixteenth bit of the data output.

e. Disconnect the BIT 16 SYNC OUTPUT from the oscilloscope and monitor the CLOCK SYNC OUTPUT. Trigger the oscilloscope from the BIT 16 SYNC OUTPUT. Verify that the CLOCK SYNC OUTPUT has an amplitude of $>+2$ V and a duration of $\sim$15 ns and that it occurs at the rate of the pulse source (1 kHz).

SECTION IV

THEORY OF OPERATION

4.1 GENERAL DESCRIPTION

Refer to Block Diagram 41000 - 258 for the following explanation.

Externally applied clock pulses are amplified by the clock input buffer and made uniform by the clock shaping circuit. These uniform pulses, through the gating circuit, drives the counter continuously when the recycle switch is in the auto position. However, when the recycle switch is in the command position the clock pulses are passed only when a recycle command is received from the manual recycle switch or recycle command input.

Each clock pulse applied to the counter advances the counter one step, until one data cycle or 16-bit word is complete. After the sixteenth bit the cycle begins again. The counter output sequentially enables the sixteen stages of the multiplexer. The logical state (true or false) of each multiplexer stage is determined by the data content pushbutton. As each state is enabled a data bit occurs at the output of the multiplexer.

The multiplexer output is fed to the advance data buffer and is supplied at the front panel as the advanced data output. Its output is also fed to the data forming circuit and the output amplifier which provides power gain and variable adjustment of the data logic levels. Positive true and complement data is also provided by the output amplifier.

The sync generator is driven by the counter output and generates a sync pulse when the first and sixteenth bit occurs. Both sync pulses are amplified and coupled to the front panel as Bit 1 and Bit 16 sync outputs. In the parallel mode of operation, the bit 16 completion circuit is disconnected. However, in the series mode of operation, when the sixteenth bit occurs, the bit 16 completion circuit disables the gating circuit and causes the data logic level of the sixteenth bit to return to zero one bit period after it begins. This allows several units to be connected in series for longer word lengths. The bit 16 sync also disables the recycle mode selection circuit to insure that only one data cycle occurs for each recycle command signal.

4.2 DETAILED CIRCUIT DESCRIPTION

Refer to Schematic 40000 -491 for the circuit descriptions in paragraph 4.2.1 through 4.2.8.

4.2.1 Clock Circuits

The manual clock circuit consists of integrated circuit Z3 (R/S flip-flop and nand gate) and its associated circuitry. Resistor R24, capacitor C22 and Z3 comprise a one-shot multivibrator. The negative-going pulse generated by depressing manual clock switch S21, is differentiated by C21 and R22. Diode CR21 allows only the negative half of the differentiated pulse to trigger the one-shot multivibrator. The width of the one-shot output pulse is determined by the time required to charge C22. Capacitor C26 and resistor R28 differentiate the one-shot output and diode CR25 allows only the positive half (the trailing edge half) of the differentiated pulse to be coupled to the base of Q6.

The external clock circuit consists of transistors Q4 and Q5 which function as a Schmitt trigger. With no clock input Q4 is off and Q5 is on, since its base is biased at approximately +1.7 V by R26, R29 and zener diode CR24. When the external clock pulse at the base of Q4 exceeds +0.5 V, Q4 turns on and Q5 turns off. When the input pulse drops below +0.5 V the circuit is returned to the quiescent state.

Transistor Q6 inverts and amplifies the pulses from the manual or external clock circuit. These pulses trigger one-shot multivibrator Z4 to develop 15 ns wide positive clock pulses for the gating circuit. The negative-going pulses at pin 8 of Z4 are amplified by Q7 and coupled to the front panel as the clock sync output.

4.2.2 Recycle Circuits

The manual recycle circuit (Z1 and associated circuitry) functions the same as the manual clock circuit and the recycle command circuit (Q1, Q2 and Q3) function the same as the external clock circuit described in paragraph 4.2.1. When the command recycle mode is selected, pin 5 of Z1 is at +5 V, therefore, when the negative-going pulse from either the manual recycle or recycle command occurs at the collector of Q3, a positive-going pulse occurs at pin 6 of Z1. This positive-going pulse triggers one-shot multivibrator Z2 which generates a negative-going pulse with a width of approximately 15 ns. The gating circuit is enabled by this pulse and 16 clock pulses are allowed to pass for each command pulse.

In the auto recycle mode, pin 5 of Z1 is at ground and with no pulse at the recycle command input, pin 4 is held at approximately +3 volts by the collector of Q3. With pin 5 (Z1) at ground, the output of Z2 will be low (ground) which will enable the gating circuit and allow clock pulses to pass uninterrupted.

4.2.3 Gating Circuit

The gating circuit controls the clock input to the data generation circuits. The circuit is comprised of integrated circuit Z7 which is connected as a R/S flip-flop, nand gate and an inverter. The inputs to the R/S flip-flop are the recycle command and $\overline{\text{Bit 16}}$ sync outputs and the inputs to the nand gate are the R/S flip-flop and clock outputs.

In the auto recycle mode, pin 13 (Z7) is low causing pin 2 to be high. Consequently, each time a clock pulse is applied at pin 1, a positive-going pulse is generated at pin 6.

In the command recycle mode, pin 13 is high until a command pulse is applied. At that time pin 13 goes low causing pin 2 to go high thereby allowing the clock pulses to be passed. When $\overline{\text{Bit 16}}$ sync output occurs (approximately 30 ns before the sixteenth bit), the output of the R/S flip-flop (pin 11) goes high and the clock pulses can no longer pass.

4.2.4 Data Generation Circuits

The data generation circuits consist of counter Z8, multiplexer Z10 and flip-flop Z11. The gated clock input to pin 2 of Z8 generates a binary output at pins 11, 12, 13 and 14. Output "1" (pin 14) occurs at one-half the clock rate, output "2" (pin 13) at one-fourth the clock rate, output "4" (pin 12) at one-eighth the clock rate, and output "8" (pin 11) at one-sixteenth the clock rate. The four counter outputs ("1", "2", "4" and "8") enable the 16 stages of the multiplexer which generates a logical 0 at Z10 pin 10 (approximately 0 V) for each stage where the data content pushbutton is depressed and a logical 1 (approximately +3 V) for each stage where the data content pushbutton is released. The multiplexer output (ADVANCED $\overline{\text{DATA}}$) and the inverted multiplexer output (ADVANCED DATA) drive data forming flip-flop Z11. When the J input of Z11 is a logical 1 (approximately +3 V) and the K input is a logical 0 (approximately 0 V), the $\overline{Q}$ output changes logic levels when the clock pulse is applied. However, when the J input is a logical 0 and the K input is a logical 1, the $\overline{Q}$ output remains at the same logic level when the clock pulse is applied.

4.2.5 Sync Generator

The sync generator generates sync outputs at approximately the same times as Bit 1 and Bit 16. The circuit is comprised of multiple nand gate Z9 and multiple inverter Z6.

Bit 1 sync is generated by nanding counter outputs "2", "4" and "8" at Z9 pins 9, 10 and 11, then nanding the inverted output from Z9 pin 8 with counter output "1" and the gated clock. The resulting output at Z9 pin 11, Bit 1 sync, is inverted and current drive is developed by Q301.

Bit 16 sync is generated by nanding inverted output "1", the output from Z6 pin 2 (the inverted nand output of counter outputs "2", "4" and "8") and the gated clock. The resulting output at Z9 pin 6, Bit 16 sync, is inverted and current drive is developed by Q302.

4.2.6 Bit 16 Completion Circuit

When Bit 16 is selected true (data content pushbutton depressed) and the instrument is connected for parallel operation (jumper between PP and G), Bit 16 of the data output remains at the upper level voltage until a recycle command is applied. However, when the instrument is connected for serial operation (jumper between NN and PP), Bit 16 of the data output returns to the lower level after one bit period.

The bit 16 completion circuit is comprised of a R/S flip-flop (¾ of Z5), an inverter (1/6 of Z6) and a nand gate (¼ of Z5). When the instrument is connected for serial operation, the inputs to nand gate Z5 are both low (0.5 V or less). With both inputs low, the preset input to flip-flop Z11 is approximately +3 V. When the sixteenth data bit occurs, Bit 16 sync at pin 13 of Z5 causes the R/S flip-flop to change state and allows the next clock pulse to pass through the gate and the inverter to be widened by R51 and C52, inverted by the AND gate (¼ of Z5) and delayed by R52, C53 and the two inverters (4/6 of Z6). This widened, delayed pulse at the preset input of the counter causes the data to return to zero one bit period after the beginning of Bit 16. The pulse at pin 3 of Z5 also resets the R/S flip-flop.

When the instrument is connected for parallel operation, pin 4 of nand gate Z5 is held at +5 V, which places a low at the preset input (pin 13) of Z11. Consequently, the positive pulse caused at Z5 pin 2 when Bit 16 sync occurs, does not change the low at the preset input of Z11 and the data output remains at the upper level.

4.2.7 Output Amplifier Circuits

Final amplification of NRZ advanced, complement and true data is provided by the output amplifier circuits. Transistors Q311 through Q313 comprise the advanced data amplifier and transistors Q309, Q310 and Q314 through Q324 comprise the NRZ positive true and complement data output amplifiers.

The NRZ advanced data amplifier is an inverting amplifier whose input is the advanced data from the multiplexer. Transistor Q311 is biased off at one diode drop below ground (approximately -0.7 V) and conducts when the input data bit is high (+3 V). The collector of Q311 swings between ground (transistor on) and +5 V (transistor off). When the collector is at +5 V, Q312 conducts and when the collector is at ground, Q313 conducts. Diodes CR308 and CR309 provide bias from Q312 and Q313. Diode CR310 keeps the emitter of Q312 from going more positive than one diode drop above +5 V and diode CR311 keeps the emitter of Q313 from going more negative than one diode drop below ground.

Differential amplifier Q309/Q310 is the input to the NRZ positive true and complement amplifiers. Zener diode CR306 level shifts the incoming data to approximately +9.1 V. With no data input, Q309 is on and Q310 is off since the base of Q310 is approximately +10 V. When the input data bit is high, Q309 is on and Q310 is off. The collectors of Q309 and Q310 apply pulses of opposite polarity to the bases of differential amplifier Q322/Q323. Transistor Q324 is the current source for differential amplifier Q322/Q323. The collector of Q323 drives parallel output transistor Q316/Q317 and Q320/Q321 for the positive true data output and the collector of Q322 drives the parallel output transistors Q314/-Q315 and Q318/Q319 for the complement data out-

put. The limits of the collector swing for Q322 and Q323 are determined by the magnitude of V_{UL} (upper level voltage) and V_{LL} (lower level voltage). Diodes CR318 and CR320 are the upper level (V_{UL}) clamp diodes and diodes CR319 and CR321 are the lower level (V_{LL}) clamp diodes. Diodes CR322 and CR323 provide bias for the positive true data output transistors (Q316, Q317, Q320 and Q321) and diodes CR316 and CR317 provide bias for the complement data output transistors (Q314, Q315, Q318 and Q319). Zener diode CR324 and CR325 prevent the output from going more positive than +10 volts and zener diode CR327 and CR326 prevent the output from going more negative than -10 volts. Similar protection for the complement output is provided by diodes CR312 through CR315.

4.2.8 Output Levels

Control of the upper and lower levels of the output data is provided by the output levels circuit. This circuit is comprised of transistors Q303 through Q308 and their associated components. Upper level control R313, varies the voltage on the base of Q305 from approximately -11 to +9 V, therefore the upper level voltage (V_{UL}) at the emitter of Q305 varies from approximately -10.3 to +9.7 V. Voltage V_{C1} (at the emitter of Q304) which is the collector voltage for output transistors Q314 through Q317 tracks V_{UL} by approximately +5 volts. Transistor Q303 is the current source for Q305.

The lower level voltage control functions the same as the upper level with the exception that V_{C2} (collector voltage for output transistors Q318 through Q321) tracks the lower level voltage (V_{LL}) by approximately +3 volts.

4.2.9 Power Supply

The power supply consists of +15 V, -15 V and +5 V regulators. The operation of all three regulators are basically the same, therefore only the +15 volt regulator will be described in detail.

Reference for the regulator is provided by zener diode CR507. Transistor Q501 supplies base current to series pass transistor Q502. If the regulator output goes above +15 V, Q504 conducts more which decreases the base current to Q502. This decrease in base current of Q502 decreases the emitter current and consequently the regulator output decreases. If the regulator output goes below +15 V, Q504 conducts less which increases the base current to Q502. This increase in base currents increases the emitter current and consequently the regulator output increases.

Transistor Q503 provides over current protection for the regulator when the overcurrent condition occurs, Q503 is biased on by the increased voltage drop across R506 and the base current of Q502 is shunted to Q503 limiting the output current.

Over voltage protection for the +5 V regulator is provided by zener diode CR517 and silicon controlled rectifier CR518. If the voltage at the regulator output goes above 5.6 V, the gate of CR518 is biased on and the regulator output is shorted to ground through SCR CR518. To reset the +5 V regulator, the power switch must be turned off.

NOTE: Under certain conditions, a signal input may cause the SCR to remain on when the power switch is off. Therefore, it may be necessary to remove the signal inputs when resetting CR518.

SECTION V

PARTS LIST

5.1 ABBREVIATIONS AND SYMBOLS

5.1.1 Reference Designations

The reference designations used in this parts list correspond to the ones used in the following schematics:

Drawing Number 40000-490
Drawing Number 40000-491

Reference designators are as follows:

capacitor	C
inductor	L
transistor	Q
resistor	R
switch	S
fuse	F
diode	CR
indicator lamp	DS
transformer	T
integrated circuit	Z

5.1.2 Abbreviations

ampere	A
double-pole-double-throw	DPDT
kilohm	k
megohm	M
microfarad	μF
milliwatt	mW
picofarad	pF
printed circuit board	PCB
root mean square	rms
variable	Var.
volts	V
watts	W

5.1.3 Manufacturers

Allen Bradley Company	AB
Amphenol RF Division	Amphenol
Arco Electronics Incorporated	Arco
Bussman Manufacturing Company	Buss
Corning Glass Works	Corning
Datapulse Division, Systron-Donner Corporation	DP
Fairchild Semiconductor Products, Incorporated	FT
Isostat (France)	Isostat
Motorola Semiconductor Products, Incorporated	Mot.
Nashville Electronics	Nashville
Ohmite Manufacturing Company	Ohmite
RV Weatherford Corporation	RVW
Sprague Electric Company	Sprague
Sylvania Electric Products Incorporated	Syl.
Texas Instruments	TI

5.2 FRONT PANEL ASSEMBLY

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
R313	20053-102	2	Var., 1 k, ½ W, 10%	AB	JA1N056S102UA
R317			Same as R313		

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
R501	10011-273	1	27 k, ½ W, 5%	AB	EB2735
S1	15300-001	2	Pushbutton	DP	
S2	15310-002	1	Slide, DPDT	Isostat	CD10
S21			Same as S1		
S501	15280-002	1	Toggle, DPDT	DP	
	15050-000	8	BNC Connectors	Amphenol	31-221-1050
5.3	**DATA CONTENT PCB ASSEMBLY**				
R61	10010-102	1	1 k, ¼ W, 5%	AB	CB1025
S61—S76	A15301-002	1	Push-Push 17 Station	DP	
	C38000-454	1	Printed Circuit Board	DP	
5.4	**MAIN PCB ASSEMBLY**				
C1	11241-223	41	0.022 μF, 25 V	Sprague	HY525
C2	11491-476	3	47 μF, 15 V	Sprague	196D476X020LA1
C3	11077-391	2	390 pF, 500 V, 5%	Arco	DM15F391J
C4 thru C9			Same as C1		
C10	11077-330	1	33 pF, 500 V, 5%	Arco	DM15E330J
C21			Same as C1		
C22			Same as C2		
C23			Same as C3		
C24 thru C29			Same as C1		
C30	11077-560	1	56 pF, 500 V, 5%	Arco	SCDM10-560J
C31			Same as C1		
C32	11077-220	5	22 pF, 500 V, 5%	Arco	DM15E220J
C51			Same as C1		
C52			Same as C32		
C53			Same as C32		
C54			Same as C1		
C55			Same as C1		
C61			Same as C1		
C62			Same as C1		
C63			Same as C1		
C64			Same as C1		
C301			Same as C1		
C302			Same as C32		
C303			Same as C1		
C304			Same as C32		
C305	11491-226	4	22 μF, 20 V	Sprague	196D226X0025LA3
C306			Same as C305		
C307			Same as C1		

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
C308			Same as C1		
C309	11077-390	1	39 pF, 500 V, 5%	Arco	DM15E390J
C310 thru C323			Same as C1		
C324	11077-680	1	68 pF, 500 V, 5%	Arco	DM15E680J
C325			Same as C1		
C501	11162-108	2	1000 μF, 50 V	Nashville	36-1.000BP1000-50S65
C502			Same as C305		
C503			Same as C501		
C504			Same as C305		
C505	11161-358	1	35000 μF, 25 V	STM	23C25TA352
C506			Same as C2		
L301	14294-332	2	3.3 μH, 10%, 500 mA	RVW	1025-32
L302			Same as L301		
Q1	22635-003	14	Silicon, NPN	DP	DP633
Q2			Same as Q1		
Q3	22605-008	10	Silicon, PNP	DP	DP608
Q4			Same as Q1		
Q5			Same as Q1		
Q6			Same as Q3		
Q7			Same as Q3		
Q301			Same as Q3		
Q302			Same as Q3		
Q303	12605-005	4	Silicon, PNP	FT	2N3638
Q304	12695-001	1	Silicon, NPN	RCA	2N2270
Q305	12605-002	5	Silicon, PNP	Mot.	2N2904A
Q306	12645-017	2	Silicon, NPN	Mot.	MPS U02
Q307	12695-007	1	Silicon, NPN	Sprague	TZ82
Q308			Same as Q305		
Q309			Same as Q305		
Q310			Same as Q305		
Q311			Same as Q1		
Q312			Same as Q1		
Q313			Same as Q3		
Q314			Same as Q1		
Q315			Same as Q1		
Q316			Same as Q1		
Q317			Same as Q1		
Q318			Same as Q3		
Q319			Same as Q3		
Q320			Same as Q3		
Q321			Same as Q3		
Q322			Same as Q1		

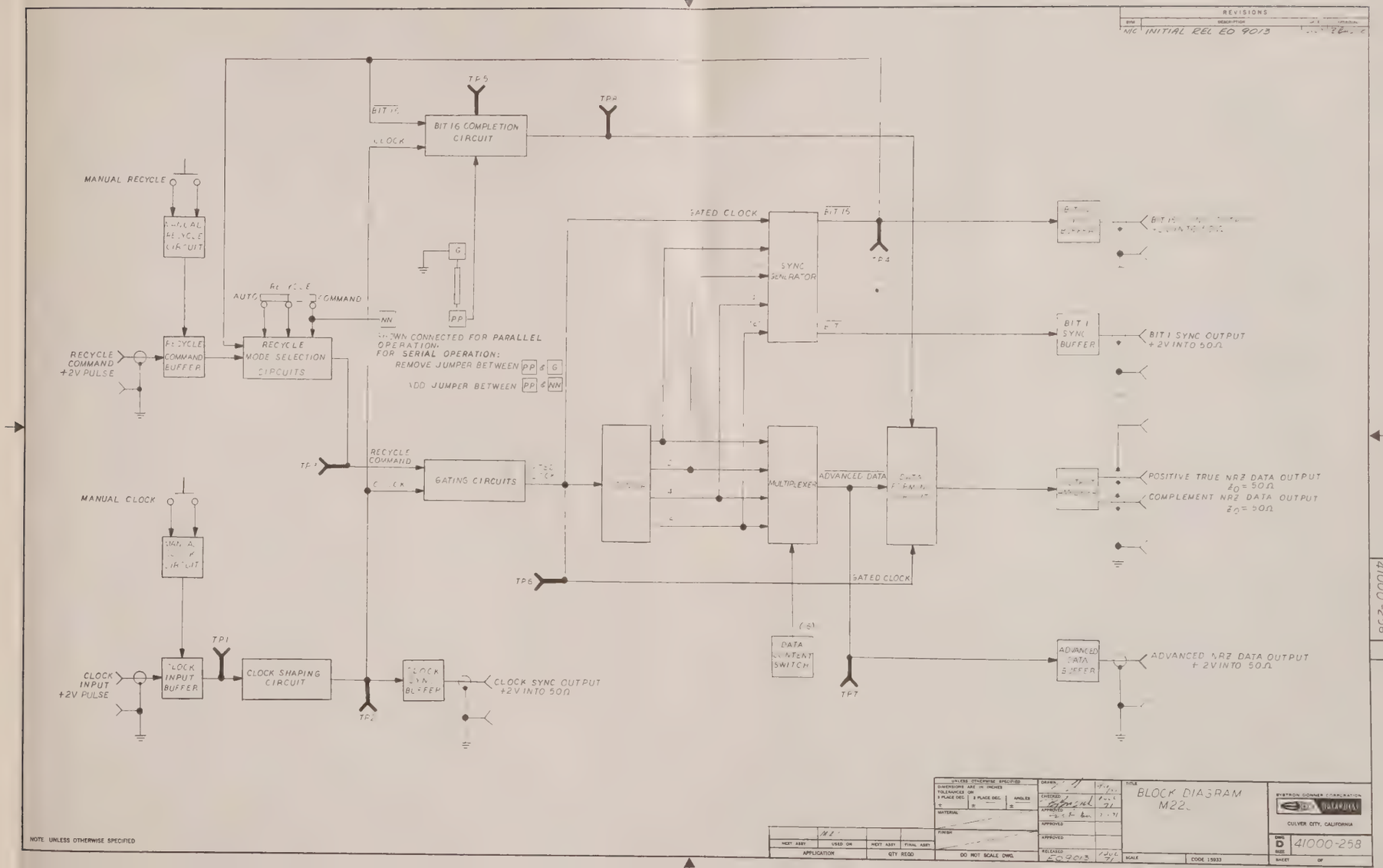
REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
Q323			Same as Q1		
Q324			Same as Q306		
Q501			Same as Q305		
Q503	12635-998	2	Silicon, NPN	FT	2N3641
Q504			Same as Q503		
Q505	12645-002	1	Silicon, NPN	Mot.	2N2219A
Q506			Same as Q303		
Q508			Same as Q303		
Q509			Same as Q303		
Q511			Same as Q1		
Q512			Same as Q1		
R1	10010-104	2	100 k, ¼ W, 5%	AB	CB1045
R2	10010-102	11	1 k, ¼ W, 5%	AB	CB1025
R3			Same as R2		
R4	10010-221	9	220 ohm, ¼ W, 5%	AB	CB2215
R5	10011-391	4	390 ohm, ½ W, 5%	AB	EB3915
R6			Same as R5		
R7	10010-301	4	300 ohm, ¼ W, 5%	AB	CB3015
R8	10010-751	2	750 ohm, ¼ W, 5%	AB	CB7515
R9	10010-820	2	82 ohm, ¼ W, 5%	AB	CB8205
R10	10010-101	14	100 ohm, ¼ W, 5%	AB	CB1015
R11	10011-102	2	1 k, ½ W, 5%	AB	EB1025
R12	10010-152	3	1.5 k, ¼ W, 5%	AB	CB1525
R13	10011-511	2	510 ohm, ½ W, 5%	AB	EB5115
R14	10010-151	7	150 ohm, ¼ W, 5%	AB	CB1515
R15	10010-103	4	10 k, ¼ W, 5%	AB	CB1035
R16			Same as R2		
R17			Same as R10		
R21			Same as R1		
R22			Same as R2		
R23			Same as R2		
R24			Same as R4		
R25			Same as R5		
R26			Same as R5		
R27			Same as R7		
R28			Same as R8		
R29			Same as R9		
R30			Same as R10		
R31			Same as R11		
R32			Same as R12		
R33			Same as R13		
R34			Same as R14		
R35			Same as R15		

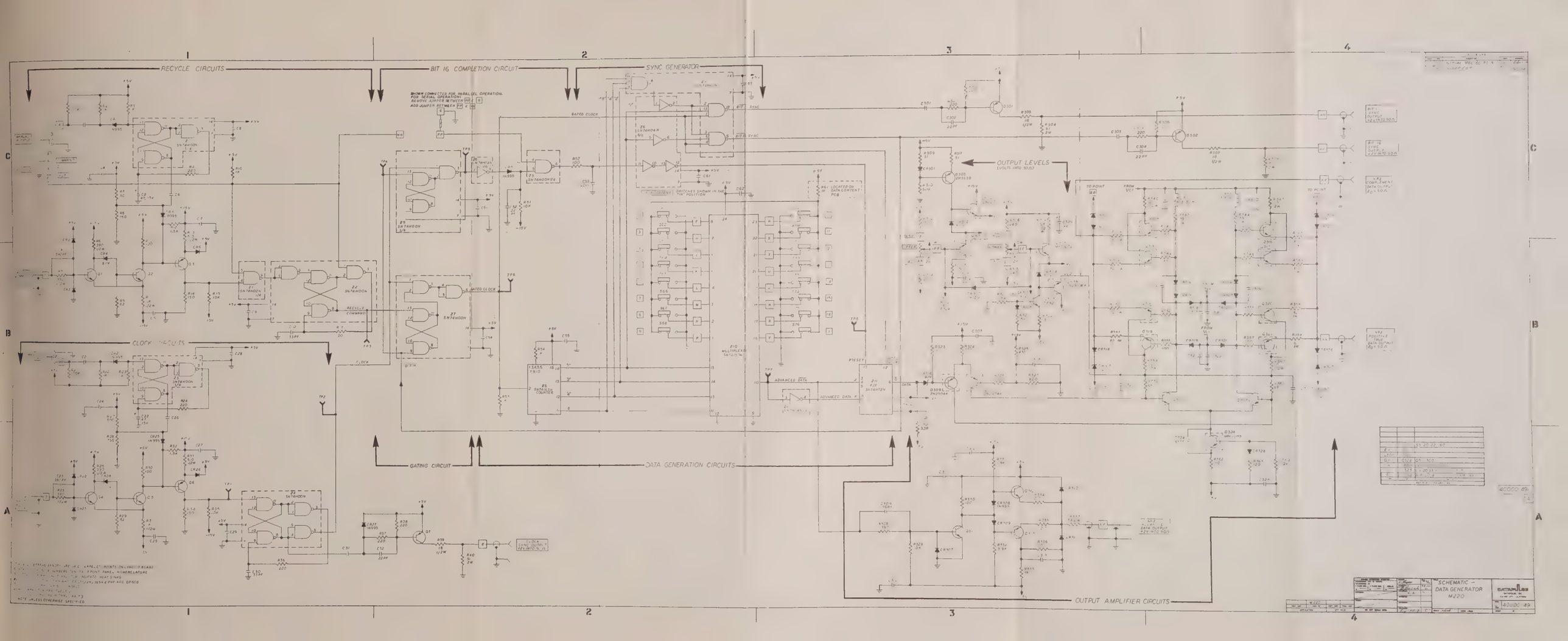
REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
R36			Same as R4		
R37			Same as R4		
R38			Same as R4		
R39	10011-180	3	18 ohm, ½ W, 5%	AB	EB1805
R40	10723-510	3	51 ohm, 2 W, 5%	Corning	RL42S510J
R51			Same as R15		
R52			Same as R10		
R53			Same as R2		
R54			Same as R2		
R62	10010-331	1	3.3 k, ¼ W, 5%	AB	CB3315
R301			Same as R4		
R302			Same as R4		
R303			Same as R39		
R304			Same as R40		
R305			Same as R4		
R306			Same as R4		
R307			Same as R39		
R308			Same as R40		
R309	10010-510	4	51 ohm, ¼ W, 5%	AB	CB5105
R310	10010-512	1	5.1 k, ¼ W, 5%	AB	CB5125
R311			Same as R309		
R312			Same as R7		
R314	10010-201	1	200 ohm, ¼ W, 5%	AB	CB2015
R315			Same as R14		
R316	10010-241	2	240 ohm, ¼ W, 5%	AB	CB2415
R318			Same as R316		
R319	10011-680	1	68 ohm, ½ W, 5%	AB	EB6805
R320			Same as R12		
R321			Same as R309		
R322			Same as R309		
R323			Same as R2		
R324			Same as R7		
R325	10010-431	1	430 ohm, ¼ W, 5%	AB	CB4135
R326			Same as R10		
R327	10010-821	1	820 ohm, ¼ W, 5%	AB	CB8215
R328	10010-391	1	390 ohm, ¼ W, 5%	AB	CB3915
R329			Same as R15		
R330			Same as R10		
R331	10010-182	2	1.8 k, ¼ W, 5%	AB	CB1825
R332	10010-392	3	3.9 k, ¼ W, 5%	AB	CB3925
R333			Same as R2		
R334	10010-279	2	2.7 ohm, ¼ W, 5%	AB	CB27G5
R335			Same as R334		

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
R336			Same as R10		
R338	10012-820	8	82 ohm, 1 W, 5%	AB	GB8205
R339			Same as R338		
R340	10011-100	4	10 ohm, ½ W, 5%	AB	EB1005
R341			Same as R14		
R342			Same as R14		
R343	10012-391	2	390 ohm, 1 W, 5%	AB	GB3915
R344			Same as R343		
R345			Same as R14		
R346			Same as R14		
R347			Same as R340		
R348			Same as R338		
R349			Same as R338		
R350			Same as R338		
R351			Same as R338		
R352			Same as R10		
R353			Same as R10		
R354			Same as R340		
R355	10010-680	2	68 ohm, ¼ W, 5%	AB	CB6805
R356			Same as R10		
R357			Same as R10		
R358			Same as R338		
R359			Same as R338		
R360			Same as R340		
R361			Same as R355		
R362	10010-300	1	30 ohm, ¼ W, 5%	AB	CB3005
R363	10010-121	1	120 ohm, ¼ W, 5%	AB	CB1215
R364	10010-122	1	1.2 k, ¼ W, 5%	AB	CB1225
R502	10010-330	3	33 ohm, ¼ W, 5%	AB	CB3305
R503	10011-222	2	2.2 k, ½ W, 5%	AB	EB2225
R504	10010-331	3	330 ohm, ¼ W, 5%	AB	CB3315
R505	10010-180	2	180 ohm, ¼ W, 5%	AB	CB1815
R506	10264-229	3	2.2 ohm, 3 W, 5%	Ohmite	4388
R507			Same as R332		
R508			Same as R10		
R509			Same as R502		
R510			Same as R503		
R511			Same as R504		
R512			Same as R505		
R513			Same as R332		
R514			Same as R506		
R515			Same as R2		
R517			Same as R502		

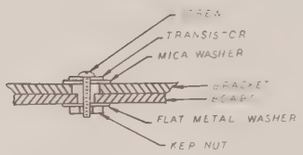
REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
R518			Same as R2		
R519			Same as R10		
R520	10010-161	1	160 ohm, ¼ W, 5%	AB	CB1615
R521			Same as R506		
R522			Same as R331		
R523			Same as R10		
R524			Same as R504		
Z1	12923-000	6	Quad 2 Input Nand Gate	TI	SN74H00N
Z2			Same as Z1		
Z3			Same as Z1		
Z4			Same as Z1		
Z5			Same as Z1		
Z6	12923-012	1	Hex Inverter	TI	SN74H04N
Z7			Same as Z1		
Z8	12923-014	1	4 Bit Binary Sync Counter	TI	SN74163N
Z9	12923-009	1	3 Input Nand Gate		SN74H10N
Z10	12923-015	1	16 to 1 Line Data Selector/-Multiplexer	TI	SN74150N
Z11	12923-007	1	J-K Master Slave Flip-Flop	TI	SN74H72N
CR1	12144-003	7	Germanium	Syl.	1N995
CR2	22164-000	31	Silicon	DP	DP16-0
CR3			Same as CR2		
CR4	22314-519	3	Zener, 5.1 V, 400 mW, 5%	DP	DP31-519
CR5			Same as CR1		
CR6			Same as CR2		
CR21			Same as CR1		
CR22			Same as CR2		
CR23			Same as CR2		
CR24			Same as CR4		
CR25			Same as CR1		
CR26			Same as CR2		
CR27			Same as CR1		
CR51			Same as CR1		
CR301			Same as CR2		
CR302			Same as CR4		
CR303	22314-829	1	Zener, 8.2 V, 400 mW, 5%	DP	DP31-829
CR304	22314-339	1	Zener, 3.3 V, 400 mW, 5%	DP	DP31-339
CR305			Same as CR2		
CR306	22314-919	1	Zener, 9.1 V, 400 mW, 5%	DP	DP31-919
CR307			Same as CR2		
CR308			Same as CR1		
CR309			Same as CR2		
CR310			Same as CR2		

REF. NO.	DATAPULSE PART NO.	QTY. USED	DESCRIPTION	MFR.	MFR. PART NO.
CR311			Same as CR2		
CR312	22314-100	2	Zener, 10 V, 400 mW, 5%	DP	DP31-100
CR313			Same as CR2		
CR314			Same as CR2		
CR315	22314-110	2	Zener, 11 V, 400 mW, 5%	DP	DP31-110
CR316 thru CR323			Same as CR2		
CR324			Same as CR312		
CR325			Same as CR2		
CR326			Same as CR2		
CR327			Same as CR315		
CR328			Same as CR2		
CR501	22194-001	8	Silicon	DP	DP19-1
CR502			Same as CR501		
CR503			Same as CR501		
CR504			Same as CR501		
CR505			Same as CR2		
CR506			Same as CR2		
CR507	22324-150	2	Zener, 15 V, 1 W, 5%	DP	DP32-150
CR508			Same as CR2		
CR509			Same as CR2		
CR510			Same as CR501		
CR511			Same as CR501		
CR512			Same as CR501		
CR513			Same as CR501		
CR514			Same as CR2		
CR515			Same as CR2		
CR516	22314-179	1	Zener, 4.7 V	DP	DP31-479
CR517	22314-569	1	Zener, 5.6 V, 400 mW, 5%	DP	DP31-569
CR518	12375-000	1	SCR, 4A rms, 30 V	Mot.	MCR07-1
CR519			Same as CR507		
5.5	**BACK PANEL ASSEMBLY**				
F501	15470-011	1	0.5A, Fast Blow	Buss	AGC-½
Q502	12666-000	2	Silicon, NPN	Mot.	2N4921
Q507	12616-000	1	Silicon, NPN	Mot.	2N4918
Q510			Same as Q502		
S502	B15310-003	1	Slide Switch	DP	
T501	B24010-037	1	Power Transformer	DP	

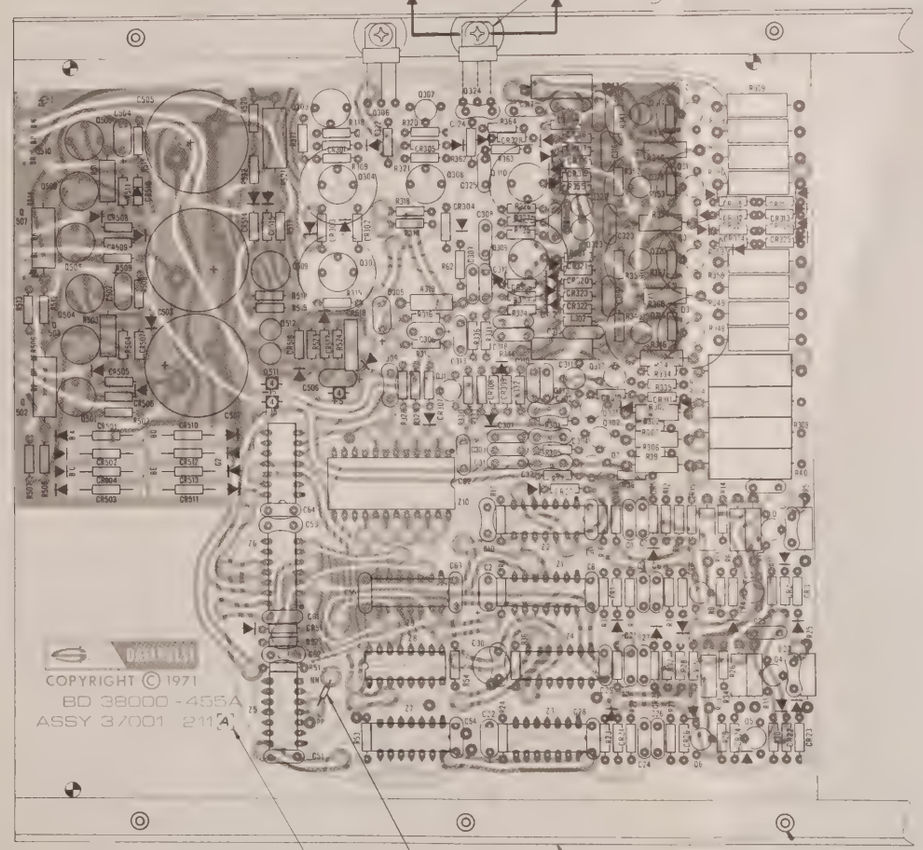

REVISIONS
NIC INITIAL REL EO 9013
BIT 16 COMPLETION CIRCUIT
BIT 16
CLOCK
TP5
TP3
MANUAL RECYCLE
MANUAL RECYCLE CIRCUIT
RECYCLE COMMAND +2V PULSE
RECYCLE COMMAND BUFFER
RECYCLE MODE SELECTION CIRCUITS
AUTO
COMMAND
NN
PP
G
SHOWN CONNECTED FOR PARALLEL OPERATION.
FOR SERIAL OPERATION:
REMOVE JUMPER BETWEEN PP & G
ADD JUMPER BETWEEN PP & NN
RECYCLE COMMAND
GATING CIRCUITS
MANUAL CLOCK
MANUAL CLOCK CIRCUIT
CLOCK INPUT +2V PULSE
CLOCK INPUT BUFFER
TP1
CLOCK SHAPING CIRCUIT
TP2
CLOCK SYNC BUFFER
CLOCK SYNC OUTPUT +2V INTO 50Ω
GATED CLOCK
SYNC GENERATOR
BIT 16
TP4
BIT 1 SYNC BUFFER
BIT 1 SYNC OUTPUT +2V INTO 50Ω
MULTIPLEXER
ADVANCED DATA
DATA FORMATTER
TP6
DATA CONTENT SWITCH
TP7
ADVANCED DATA BUFFER
ADVANCED NRZ DATA OUTPUT +2V INTO 50Ω
POSITIVE TRUE NRZ DATA OUTPUT Z0 = 50Ω
COMPLEMENT NRZ DATA OUTPUT Z0 = 50Ω
NOTE UNLESS OTHERWISE SPECIFIED
BLOCK DIAGRAM M22
BYSTRON DONNER CORPORATION
CULVER CITY, CALIFORNIA
41000-258
SIZE D
SCALE
CODE 15933
SHEET OF
41000-258


RECYCLE CIRCUITS
BIT 16 COMPLETION CIRCUIT
SYNC GENERATOR
CLOCK CIRCUITS
GATING CIRCUIT
DATA GENERATION CIRCUITS
OUTPUT AMPLIFIER CIRCUITS
OUTPUT LEVELS
(VOLTS INTO 50Ω)
SHOWN CONNECTED FOR PARALLEL OPERATION.
FOR SERIAL OPERATION:
REMOVE JUMPER BETWEEN P3 AND P4
ADD JUMPER BETWEEN P3 AND P5
SWITCHES SHOWN IN THE "1" POSITION
GATED CLOCK
BIT SYNC
BIT IS SYNC
ADVANCED DATA
ADVANCED DATA #
DATA
PRESET
LOCK
RECYCLE COMMAND
SYNC OUTPUT +2V INTO 50Ω
DATA OUTPUT +2V INTO 50Ω
BIT SYNC OUTPUT +2V INTO 50Ω
BIT 16 SYNC OUTPUT +2V INTO 50Ω
COMPLEMENT DATA OUTPUT +2V INTO 50Ω
POSITIVE TRUE DATA OUTPUT +2V INTO 50Ω
TO POINT B1
FROM VC1
TO POINT B2
FROM VC2
SCHEMATIC — DATA GENERATOR M220
40000-49

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	INCORP. 9085	8/31/71	



SECTION A-A (TYP 2 PLS)
SCALE NONE



37001-211
A1

1. INSTALL NO.22 BARE WIRE ON CIRCUIT SIDE 3 PLS
3. ALL TRANSISTORS ARE MOUNTED ON PADS (SEE LM)
2. MARK ASSY REV LTR IN LOCATION SHOWN, COLOR WHITE
1. REFERENCE SCHEMATIC DWG NO. D40000-490 & D40000-491
NOTE UNLESS OTHERWISE SPECIFIED

NO 22 INSULATED WIRE JUMPER (115) 2 PLS

(113) INSTALL FROM OTHER SIDE 5 PLS

SEE SEPARATE PARTS LIST-"A" SIZE SH. 2 THRU 7 OF THIS DWG

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: 3 PLACE DEC ±	2 PLACE DEC ±	ANGLES ±

MATERIAL
FINISH
DO NOT SCALE DWG

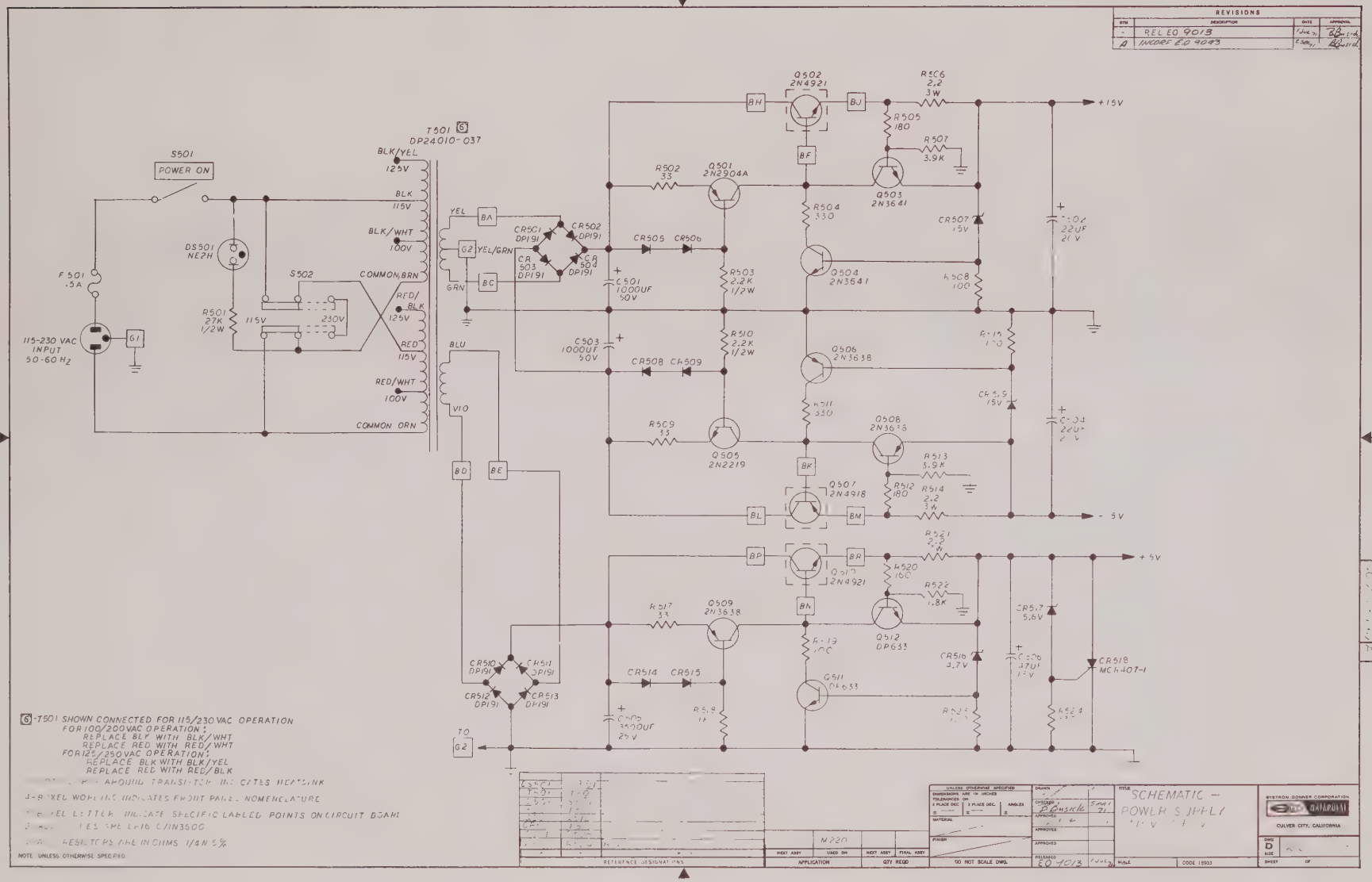
DRAWN
CHECKED Jansen 7/21/71
APPROVED
APPROVED
APPROVED
RELEASED ECO 9012 7/26/71

TITLE: CIRCUIT BOARD - ASSEMBLY M220

BYSTRON DONNER CORPORATION
DATAPULSE
CULVER CITY, CALIFORNIA

37001-214	220	1	1
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SCALE 2/1 | CODE 17933 | DWG NO D 37001-211 | SHEET 1 OF 7


REVISIONS
REL EO 9013
INCORP EO 9043
T501 DP24010-037
S501
POWER ON
F501 .5A
115-230 VAC INPUT 50-60 Hz
DS501 NE2H
R501 27K 1/2W
S502
115V
230V
BLK/YEL 125V
BLK 115V
BLK/WHT 100V
COMMON, BRN
RED/BLK 125V
RED 115V
RED/WHT 100V
COMMON ORN
YEL
YEL/GRN
GRN
BLU
VIO
CR501 DP191
CR502 DP191
CR503 DP191
CR504 DP191
C501 1000UF 50V
C503 1000UF 50V
C505 3300UF 25V
R502 33
R503 2.2K 1/2W
R505 180
R506
R507 3.9K
R508 100
R509 33
R510 2.2K 1/2W
R511 330
R512 180
R513 3.9K
R514 2.2 3W
R517 33
R520 100
R521 2.2 3W
R522 1.8K
Q501 2N2904A
Q502 2N4921
Q503 2N3641
Q504 2N3641
Q505 2N2219
Q506 2N3638
Q507 2N4918
Q508 2N3638
Q509 2N3638
Q510 2N4921
Q511 DP633
Q512 DP633
CR505 CR506
CR507 15V
CR508 CR509
CR514 CR515
CR516 3.7V
CR517 5.6V
CR518 MCR407-1
+15V
-15V
+5V
TO G2
6 -T501 SHOWN CONNECTED FOR 115/230 VAC OPERATION
FOR 100/200 VAC OPERATION:
REPLACE BLK WITH BLK/WHT
REPLACE RED WITH RED/WHT
FOR 125/250 VAC OPERATION:
REPLACE BLK WITH BLK/YEL
REPLACE RED WITH RED/BLK
NOTE UNLESS OTHERWISE SPECIFIED
M220
APPLICATION
DO NOT SCALE DWG.
SCHEMATIC – POWER SUPPLY
SYSTRON DONNER CORPORATION
CULVER CITY, CALIFORNIA
SIZE D

E. O. NO.	EFFECTIVE DATE	DWG. NO.	CHANGE
3876	3-15-72	40000-491	Move end of C26 from Z3 pins 8 and 12 to junction of Z3 pin 3 and R24. Move end of C6 from Z1 pins 8 and 12 to junction of Z1 pin 3 and R4.
4207	11-13-72	40000-490	For 230 volt operation, change the rating of the fuse to ¾ the value of the 115 V rating. Replace with nearest higher standard value (i.e.), 115 V = 1 amp, 230 V = ¾ amp.
4497	8-24-73	40000-491	Change the following resistors from ¼ W to 1 W: R314, P/N10012-201, R316 and R318, P/N10012-241 and R312 (only), P/N10012-301.

DATAPULSE DIVISION
SYSTRON DONNER

SEMICONDUCTOR REPLACEMENTS

(Applicable to all Datapulse Models except the Model 102.)

SERVICE BULLETIN 1-65
Revised 8-13-73

The listed commercial diodes and transistors may be suitable replacements for the corresponding Datapulse parts, either as direct substitutes, or as selected for the special performance characteristics given. In certain cases, it may be necessary to use the Datapulse parts.

DATAPULSE TYPE NO.	DATAPULSE PART NO.	COMMERCIAL EQUIVALENT
Diodes:		
DP15-0	22154-000	1N752A selected for $\Delta V < 0.2$ V between 7 mA and 110 mA.
DP15-1	22154-001	Same as DP15-0 but matched in pairs to within 0.1 V.
DP15-201	22154-201	1N936 selected for 9.4 V $\pm$0.1 V @25 mA.
DP16-0	22164-000	1N3600
DP16-1	22164-001	(>80 V, DP16-0)
DP19-0	22194-000	1N2070/1N4005
DP19-6	22194-006	1N2071/1N4005
Transistors:		
DP46-1	22465-001	Selected for h_{fe} = 100 min.
DP59-0	22595-000	2N2904A
DP60-1	22605-001	2N2894 selected for V_{ceo} (sust) = 20 V min.
DP60-2	22605-002	2N3133
DP60-4	22605-004	2N3209
DP60-5	22605-005	FT1702
DP60-6	22605-006	2N3640
DP60-7	22605-007	2N2894 selected for V_{ceo} (sust) = 25 V
DP60-8	22605-008	2N2894A (Motorola) V_{ceo} >20
DP63-2	22635-002	Replaced by DP63-3
DP63-3	22635-003	2N2369A (Fairchild) h_{fe} >70
DP63-4	22635-004	Replaced by DP63-3
DP63-6	22635-006	2N2219A
DP63-8	22635-008	May be replaced by 2N5109 selected for $h_{fe} \geq 20$ @I_c = 0.25 A & V_c = 2.5 V
DP63-9	22635-009	May be replaced by 2N5109 selected for $h_{fe} \geq 20$ @I_c = 0.25 A & V_c = 2.5 V
DP64-0	22645-000	May be replaced by 2N5109 selected for $h_{fe} \geq 20$ @I_c = 0.25 A & V_c = 2.5 V

DATAPULSE DIVISION, SYSTRON-DONNER CORPORATION
10150 W. JEFFERSON BLVD., CULVER CITY, CALIFORNIA 90230 • Phone: (213) 871-0410 • TWX: 910-340-6766

WARRANTY

The Datapulse Division, Systron-Donner Corporation (hereinafter referred to as Datapulse) warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse.

Datapulse reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse and Datapulse neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse instruments.

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